Cross-Generational Vowel Differences in the Spontaneous Speech of Central Ohio Speakers

A Senior Honor Thesis

Presented in Partial Fulfillment of the Requirements for Graduation with Honors Research Distinction in Speech and Hearing Science in the undergraduate colleges of The Ohio State University

by:

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Abstract

The Northern Cities Shift is a vowel chain shift (a type of sound change) that occurs in the Northern dialect region, including Northern Ohio. Consensus in the research literature is that the Northern Cities Shift is not operative in central Ohio but data that support this position are relatively old. Recent findings have suggested that speakers in the Central Ohio region do participate in a chain shift. However, the data supporting this view are based on recordings from read speech obtained under careful laboratory conditions. Spontaneous speech samples have not as yet been analyzed. The purpose of this study is to determine whether or not elements of the Northern Cities shift have spread to the spontaneous speech of Central Ohio speakers as seen in changes the positions of vowels in the acoustic vowel space across age groups. A pattern of vowel position changes would indicate a chain shift in progress. Previously collected recordings of spontaneous speech samples were transcribed and analyzed acoustically. Stressed words that contained one of the six vowels in the Northern Cities Shift were selected for analysis. The speech analysis programs Adobe Audition and TF32 were used to analyze each word token. Acoustic measurements made included word and vowel duration and the frequencies of the first three formants at three points in time (to allow an examination of spectral change). Statistical analysis of these data is still undergoing but is close to completion. Preliminary results indicate that the Northern Cities Shift is not operative in Central Ohio. However, there are more recent changes to these vowels which were found in the children's spontaneous speech which are in agreement results from read speech. Preliminary results imply that dialect boundaries are strong and dialect features do not spread freely as a function of population mobility or incidental interpersonal contacts.

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Chapter 1: Introduction

American English can be divided into several regional dialects that differ considerably in their pronunciation patterns. It is therefore important in speech and hearing science to know whether a person's speech is a characteristic of a certain dialect and/or whether the person has a speech or language disorder. In order to determine whether or not a person's speech is specific to a certain dialect, we can examine closely vowel production.

This study specifically concentrates on vowel production because vowels are considered the most salient variables that differentiate dialects (Labov, Ash, and Boberg, 2006). There are six main dialect regions in the United States, each with their own pattern of vowel production. Vowel characteristics vary not only from dialect to dialect but they also change over time within a specific dialect variety. For instance, speakers from two different generations who live in the same dialect region can pronounce differently a subset of vowels and these variations are far from random. Rather, they are systematic and have been identified in the fields of dialectology, sociolinguistics and historical phonology as vowel shifts and vowel mergers. A vowel chain shift can occur as either a pull chain or a push chain. A push chain occurs when one sound in the vowel space moves into the position of another sound and the second sound must then move to make room for the first. A pull chain occurs when one sound moves and creates an empty space that forces a second sound to move to fill the empty space. A vowel merger occurs when two sounds merge into a single sound so that contrast between two words is lost such as in *Don* and *Dawn*, a merger of /ɑ/ and /ɔ/.

The pronunciation of vowels can shift over time (a well-known form of sound change) in a language or dialect. These are common among languages with many vowels, especially in Germanic Languages. For example, the English language has experienced three main periods, Old English, Middle English,

and Modern English. There was very slight change in long vowels between the Old English and Middle English periods. By the Modern English period, however, there was a shift of all of the long vowels. This shift is known as the Great Vowel Shift. Some examples of this shift include the raising and fronting of the Middle English vowels /ā/ (as in *name*) and /ē/ (as in *sweet*) into /e/ and /i/, respectively. By looking at the history of sound change in Germanic languages, one can see that vowel shifts and mergers are to be expected over time.

1.1 Major regional dialects of American English

There are six main dialect regions in the United States. These regions include the North, the South, New England, Mid Atlantic, Midland, and the West.

Figure 1. The major dialects of American English Source: Clopper, Pisoni, & Jong, 2005, p. 2

The Northern dialect region includes the states around the Great Lakes, specifically in the cities in Northern Ohio, Northern Illinois, Eastern Michigan and Wisconsin. The Southern dialect region

includes 16 states in the South Eastern and Southern parts of the United States. These states include New Mexico, Texas, Oklahoma, Missouri, Arkansas, Louisiana, Mississippi, Tennessee, Alabama, Kentucky, Georgia, Florida, North Carolina, South Carolina, Virginia, and West Virginia. The Western dialect region includes states west of Wyoming, Colorado, and New Mexico. The Midland dialect region includes states between the northern and southern dialect regions. The New England dialect region includes the states in the North East part of the United States, specifically Maine, Vermont, New Hampshire, Massachusetts, Connecticut, and Rhode Island. The Mid Atlantic dialect region includes Maryland, New Jersey, and Delaware.

Two of the six dialect regions, the North and the South, are undergoing chains shifts. Chain shifts involve a series of coordinated vowel rotations in the acoustic space so that vowels rotate their positions like in a chain. The other four dialect regions, i.e., New England, Mid Atlantic, Midland, and the West do not undergo chain shifts but do show evidence of other vowel changes such as mergers. The Northern Cities Shift (to be described in more detail below) is a widespread chain shift in the North. It is described as the clockwise rotation of the six vowels /ɪ, ɛ, æ, ɑ, ʌ, ɔ/, such as in *bit, bet, cat, cot, but,* and *caught* (Clopper, Pisoni, & de Jong, 2005). The second major chain shift, the Southern Shift, takes place in the South. This vowel shift is different from the Northern Cities Shift. In this vowel shift the /u/ and /o/ vowels are fronted. The front, lax vowels /ɪ/ and /ɛ/ are raised and fronted and the /i/ and /e/ vowels are lowered and backed. These "reversed" positions in the vowel space are termed ɪ/i and ɛ/e reversals. Southern speakers are also known to have longer lax vowels, which reduces the distinction between tense and lax vowels for Southern speakers (Clopper et al., 2005).

Other vowel changes in American English include a merger or partial merger of the /ɑ/ and /ɔ/ vowels, termed the Low Back Merger. This merger can be found in New England, Midland and in the West and is currently the most rapidly spreading vowel change in American English (Majors, 2005;

Irons, 2007). The Mid Atlantic dialect region shows no merger, the /ɔ/ is raised, making it distinct in terms of vowel position from /ɑ/ (Clopper et al., 2005). Many studies have been conducted on vowel shifts and mergers to better understand their underlying mechanisms and sources (Labov, 1994). The present thesis focuses on vowel production across generations of central Ohio speakers and examines whether vowel characteristics change over time and whether these changes may represent a systematic shift such as the Northern Cities Shift occurring in the northern part of Ohio in the Cleveland area.

1.2. The Northern Cities Shift

This study examines the six lax vowels that are involved in the Northern Cities Shift: /ɪ, ɛ, æ, ɑ, ʌ, ɔ/. Since the Northern Cities Shift is common among the speakers in northern Ohio around Cleveland, this research will determine whether or not its traces can be found in Central Ohio around Columbus, which is within a short distance (about three-hour drive) from the north.

The Northern Cities Shift is discussed in depth in the Atlas of North American English (Labov et al., 2006). The first stage of the shift, the raising and tensing of the /æ/ vowel, was first observed in 1969 (Labov et al., 2006; Fasold, 1969). Fasold's discovery of the raising and tensing of /æ/ sparked the interest of the linguistic community which continued searching for evidence of vowel shifts. In 1972, the Northern Cities Shift was initially identified as the rotation of five vowels (Labov, Yaeger, & Steiner, 1972). Another stage, the backing of the /ʌ/ vowel, was observed later by Eckert (1986) and further discussed in Eckert (2000). Today the Northern Cities Shift is described as the rotation of the six vowels /ɪ, ɛ, æ, ɑ, ʌ, ɔ/, as shown schematically in Figure 1.

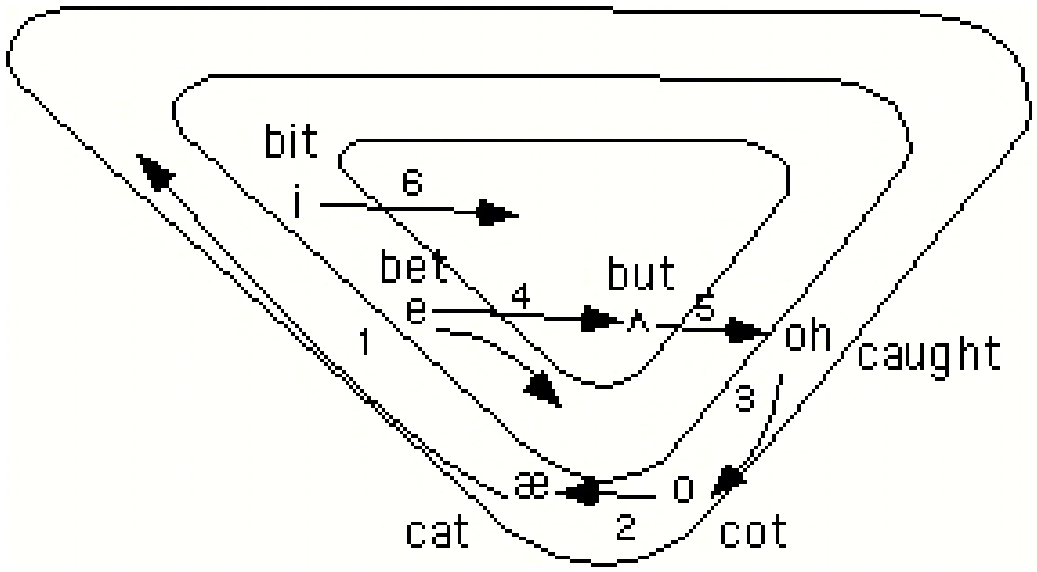

Figure 2. The six stages of the Northern Cities Shift. Source: Labov et al., 2006, p 121

As previously mentioned, the first stage of the Northern Cities Shift is the raising and fronting of /æ/. This movement of /æ/ creates an empty space to be filled by the /ɑ/ vowel which must undergo fronting. This fronting of the /ɑ/ vowel is identified as stage two. The third stage is the lowering and fronting of /ɔ/ which now moves into the position of /ɑ/. The fourth stage is the lowering and backing of /ɛ/ which now approximates the position of /ʌ/. The fifth stage is the backing of the /ʌ/ vowel. The rotation of the Northern Cities Shift ends with the backing of the /ɪ/ vowel (Labov et al., 2006). In this chain shift, with each positional vowel change another vowel is forced to move to take the space of the previous vowel.

Vowel changes resulting from the Northern Cities Shift are not equally distributed across the Northern region. In fact, not all cities in the North are affected by the Northern Cities Shift. There are concentrations of features of the chain shift in urban areas and the Northern Cities Shift is identified especially in large cities like Rochester, Syracuse, Buffalo, Cleveland, Detroit, Chicago, Kenosha, and

Milwaukee. Smaller cities may not be as involved in the complete cycle of vowel rotations and may only show particular stages of the Northern Cities Shift.

1.3. Vowel characteristics in Central Ohio

While speakers in Northern areas of Ohio have been known to participate in the Northern Cities Shift, Central Ohio speakers have not been known to participate in any chain shift (Labov et al., 2006; Thomas, 1989). However, recent findings by Jacewicz, Fox, & Salmons (2011) have suggested that speakers in the Central Ohio region do in fact participate in a chain shift. The chain shift that may be possible in Central Ohio is described as being similar to the Canadian Shift, as well as showing elements of the low back merger (Jacewicz et al., 2011).

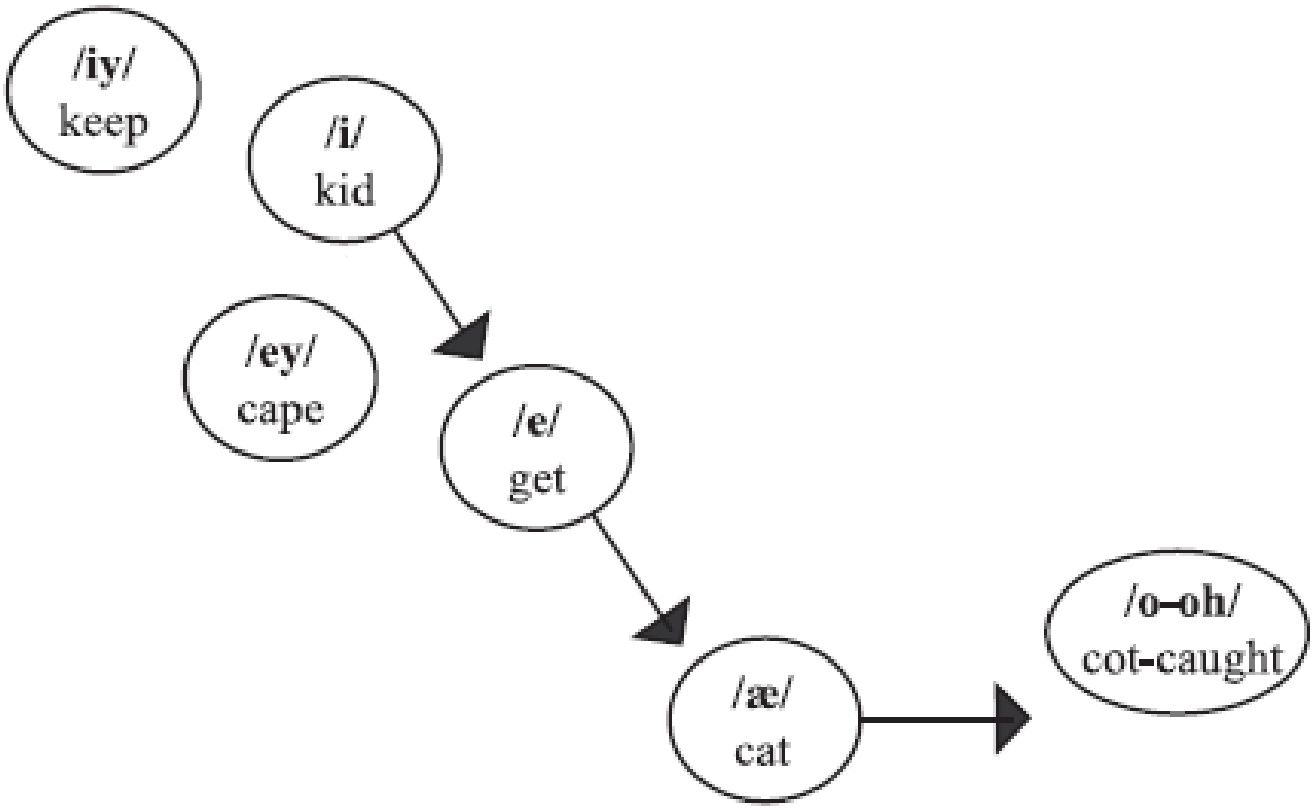

Figure 3. Canadian Vowel Shift. Source: Clarke et al., 1995, p. 42

The Canadian Shift was first reported by Clarke et al., (1995) as a vowel rotation found in Ontario, Canada. In this shift, there is a lowering of /i/ and /e/. However, unlike in the Northern Cities Shift, there is no retraction of /ɛ /, the /ʌ/ vowel lowers and becomes more centralized, the /æ/ vowel retracts and lowers instead of being raised, and there is evidence of the Low Back Merger (Clarke et al., 1995). Recent evidence suggests that the shift is a parallel vowel shift of the three vowels /ɪ, ɛ, æ/ (Boberg, 2005).

1.4 Aims of the present study

This study examines the possibility of the occurrence of the Northern Cities Shift in the spontaneous speech of Central Ohio speakers. The majority of other studies have used read speech, rather than spontaneous talks, so this represents an innovation in addressing this question. Three questions will be addressed.

1. Have elements of the Northern Cities Shift spread from the Cleveland area to the Columbus area?

2. Are there differences in vowel positions across age groups reflecting a cross-generational sound change?

3. How do the vowels of Central Ohio speakers compare to the vowels of Wisconsin speakers, who are assumed to participate in the Northern Cities Shift (Labov et al., 2006)?

Of interest is to determine if the Northern Cities Shift has spread from the Cleveland area to the Columbus area because areas of Northern Ohio have been known to participate in the Northern Cities Shift. With Cleveland being relatively close to Columbus, one would anticipate the speech of Northern Ohio, Cleveland, speakers to affect the speech of Central Ohio, Columbus, speakers. Data from Labov et al., (2006) indicate a strong dialect boundary between the North and the Midland that divides Ohio into two dialect regions. However, this data come from adult speakers representing an older generation, who interviewed between 1991 and 1993, thus about twenty years ago. The speech sample used here includes adults as well as children who represent the most recent speech patterns in Central Ohio. It might be the case that the elements of the Northern Cities Shift have spread to only this youngest population.

Since it is important to compare speech across several generations of speakers because many changes in word and vowel production can occur in cross-generational vowel transmission, this study includes three generations of speakers, old adults, young adults, and children. As previously mentioned, including children as a part of the speech sample will allow us to see the most recent changes in vowel production of Central Ohio speakers.

The vowel productions of Central Ohio speakers will be compared to the vowel productions of Wisconsin speakers because the Wisconsin region has been known to participate in the Northern Cities Shift. That is, while the Central Ohio speech is the main focus of this study, the comparison of the positions in the acoustics space of the six vowels involved in the Northern Cities Shift within these two dialect regions will allow detection of any differences between the two vowel systems that occur over generations.

The present study will examine the positional vowel changes in spontaneous speech. Spontaneous speech was used by Labov et al., (2006) in their data collection for the Atlas. However, this was a telephone survey and the quality of some recordings may have been compromised. The data in Jacewicz et al., (2011), both for the Central Ohio and Southeastern Wisconsin dialects, come from read speech obtained in careful laboratory conditions but spontaneous speech samples have not been analyzed. The present study will therefore examine whether the elements of the chain shift reported in Jacewicz et al., (2011) for Central Ohio also occur in the spontaneous speech or whether Central Ohio shows traces of the Northern Cities Shift which can be found in spontaneous speech and not in read speech.

Chapter 2: Methodology

2.1 Participants

The spontaneous speech talks used in this study were previously collected in the years 2006-2008 as a part of a larger project. Speech samples from 107 participants were selected for the present study. 53 of the participants were from Ohio and 54 were from Wisconsin. The selection criteria for subject recruitments included being born, raised and spending most of their lives in either Central Ohio (Columbus and suburbs) or Southeastern Wisconsin (Madison and suburbs), the areas of interest to the study. The regional dialect of each participant was verified by the research assistant who collected the data. The participants used in this study were not known to have any speech disorders.

The speakers were spilt into three age groups: old adults who are called here Grandparents (GP), young adults called here Parents (P), and children (C), although no actual biological relationship is expected. Collecting data from speakers representing these three generations allows for measurement of cross-generational changes in vowel production. The Ohio participants consisted of 15 old adults, 19 young adults, and 19 children split by gender as shown in Table 1. The Wisconsin participants consisted of 16 old adults, 18 young adults, and 20 children, and their gender is shown in Table 1. The participants for the two dialect groups were of comparable ages.

The age range for data collection for old adults was 68-90, for young adults 35-50, and for children 8-16. The means for each age group were 74.6, 42.0, and 10.2, respectively. Table 1 shows information for number of participants in each age and gender group as well as mean age of the participants. More details about each participant in terms of age, occupation and area of residence can be found in Appendix I.

Table1. Participant Data

Participant group	Gender	Number of participants	Mean age in years (stdev)
OH_C	M	9	11.2 (2.0)
	F	10	10.3 (1.6)
OH_P	M	8	40.8 (5.2)
	F	11	41.2 (3.8)
OH_GP	M	8	70.5 (2.3)
	F	7	73.6 (3.3)
WI_C	M	10	9.4 (0.8)
	F	10	9.8 (1.4)
WI_P	M	8	43.5 (4.2)
	F	10	42.4 (4.5)
WI_GP	M	8	74.8 (5.6)
	F	8	79.4 (7.0)

2.2 Stimuli

The stimulus material for the present study consisted of spontaneous talks produced by Ohio and Wisconsin speakers. Each talk was about 2-5 minutes in duration although some talks were even shorter. The subjects were encouraged to speak freely about their families, hobbies, vacations, plans for the upcoming weekend, work, stories from their lives, community events, etc. The original set of speech samples collected from each speaker for the larger project included isolated words, words embedded in structured sentences, and the spontaneous talks used here. The results for isolated words were previously published in Jacewicz et al., (2011a) and for the words in sentences in Jacewicz et al., (2011b). The present study focuses on the analysis of the selected vowels in variable contexts occurring in spontaneous productions, which have not been examined so far. Thus, the contribution of this study is explicating the variation in the production of these vowels in variable consonantal contexts and in

monosyllabic and polysyllabic words. Only words in stressed positions in utterances were selected for the present analysis.

A total of 1050 words from all 107 speakers were analyzed in the present study. The most frequent vowels in the sample were the /æ/ vowel, such as in the word *cat* and the /ɪ/ vowel, such as in the word *this*. The /æ/ vowel occurred 208 times, which accounts for 19.8% of all productions and the /ɪ/ occurred 201 times, 19.1% of the sample. The least frequent vowel was the /ɔ/ vowel, such as in the word *caught*. This vowel occurred only 103 times, 9.8% of all productions. The remaining vowels were represented with similar frequency. In particular, the /ɑ/ vowel occurred 183 times (17.4%), the /ʌ/ vowel 178 times (17%) and the /ɛ/ vowel 177 times (16.9%). The cumulative list of all words used for each vowel and the frequency of each word in the entire data set are shown in Appendix II.

2.3 Data Collection/Recording

Data collection for the larger corpus took place in the years 2006-2008. During a one hour session, each participant recorded words in isolation, words in sentences, and a spontaneous talk. Participants were given a nominal fee for participation. For the words in isolation and the sentence set, the test items were prompted on a computer screen and read by the participant seated in a sound-attenuating booth. This part of the recordings was controlled by a program written in Matlab. A slightly different procedure was used for the spontaneous talks. In particular, the participants were not required to attend to any prompts on the computer screen but were asked to speak freely about families, hobbies, daily lives, etc. for the purposes of obtaining a more natural speech samples representative of each dialect region. The same microphone was used but the experimenter recorded the spontaneous talks

using the program Adobe Audition. Leading questions were sometimes asked by the experimenter to engage the participant in a conversation if he/she did not know what to talk about or ran out of topics.

2.4 Data Analysis

The spontaneous talks were transcribed and analyzed acoustically. The recorded talks were listened to and words that contained the six vowels in the Northern Cities Shift (/ɪ, ɛ, æ, ɑ, ʌ, ɔ/) were selected and edited out. Only stressed words such as *this, best, bad, job, stuff,* and *bought* were selected. The speech analysis programs Adobe Audtion and TF32 were used to analyze each word token. The locations of word onset and offset and vowel onset and offset were carefully located using Adobe Audition. Vowel onset was defined as the location at the zero-crossing before the first positive peak in the periodic waveform following a word initial consonant and vowel offset was defined as the beginning of the stop closure (location of abrupt decrement in the amplitude of the waveform), which are the standard measurement criteria used in the literature (e.g., Jacewicz et al., 2011b). Because spontaneous speech talks were used, the conditions were not as controlled as typical speech production experiments where subjects record isolated words and sentences.

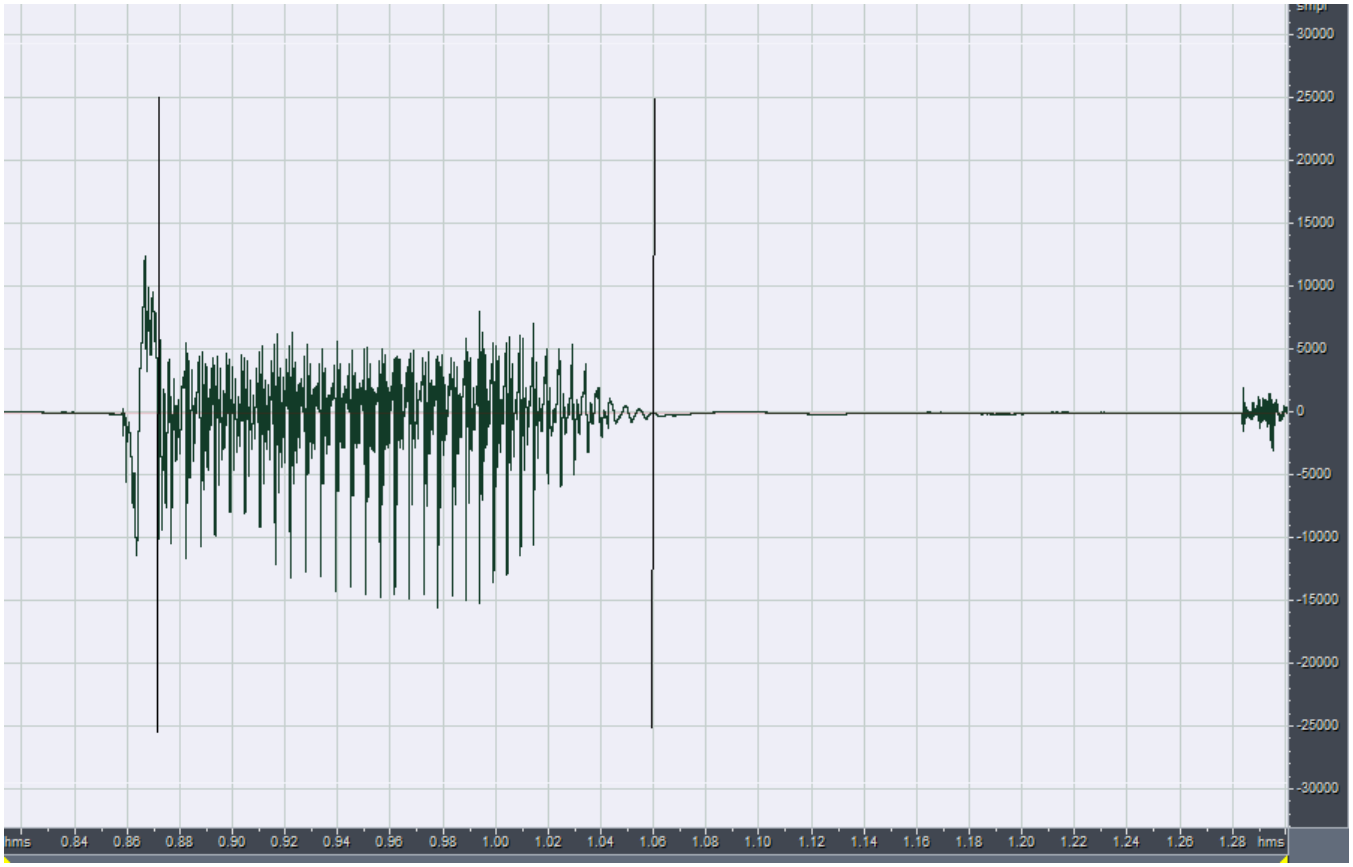

Figure 4. Example of the word "back" with vowel onset and offset shown

For example, in figure 4, the word *back* is shown. This is a word showing a voiced stop, vowel, and a voiceless stop. The vowel onset is shown by the left vertical mark. The vowel offset is shown by the right vertical mark. In this example, the stop following the vowel is a voiceless stop [k], which begins with a silent closure. In figure 5, the word *bad* is shown. This is an example of a voiced stop, vowel, and a voiced stop. The stop [d] following the vowel is voiced, which can be seen in the low energy, periodic waveform during the closure. In figure 6, the word *cats* is shown. This is an example of a voiceless stop, vowel, and a voiceless stop. In a voiceless stop there is a long voice onset time (VOT). The word *have* is shown in figure 7. This is an example of a voiceless fricative, vowel, and voiced fricative.

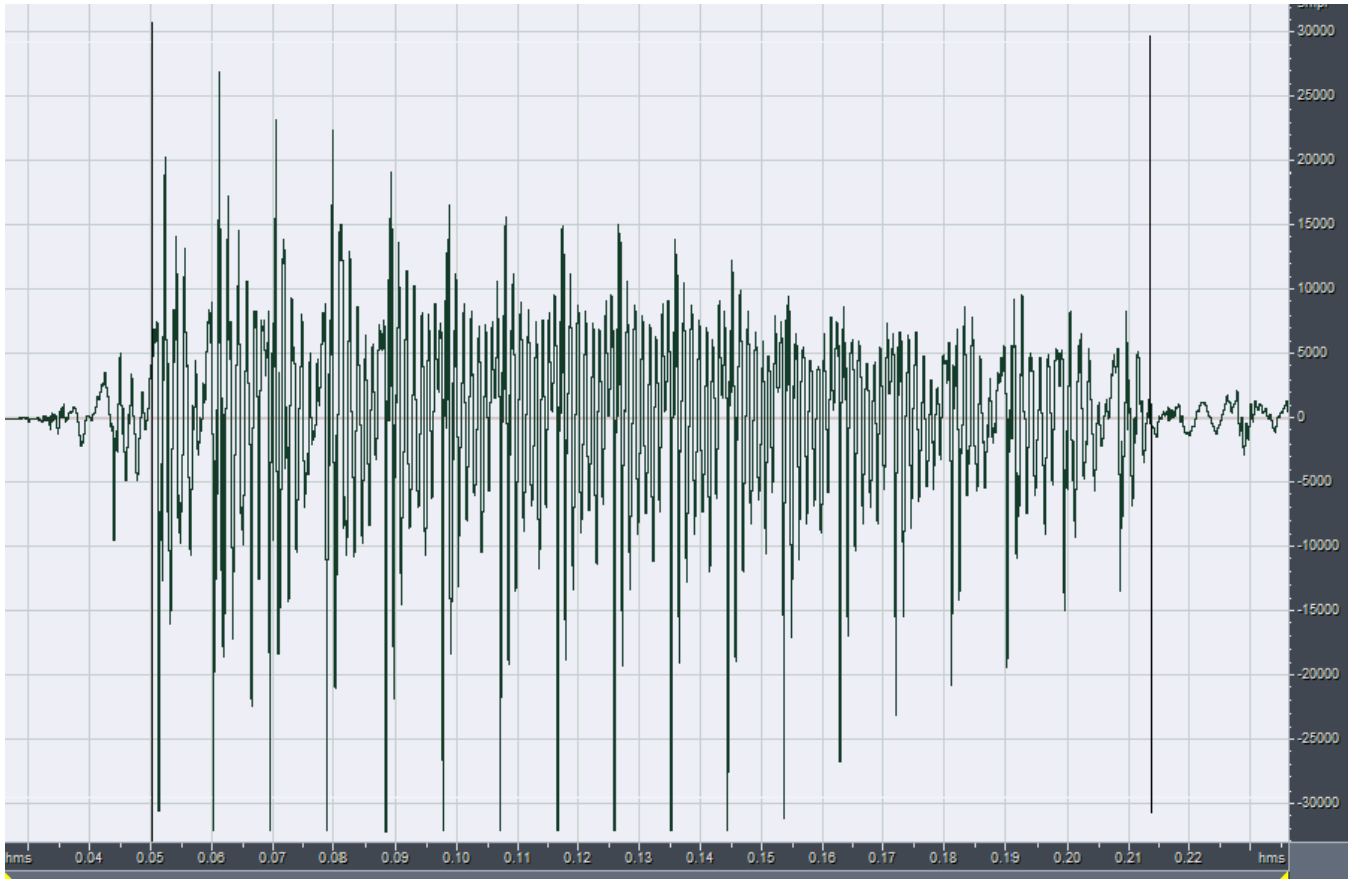

Figure 5. Example of the word “bad” with vowel onset and offset shown

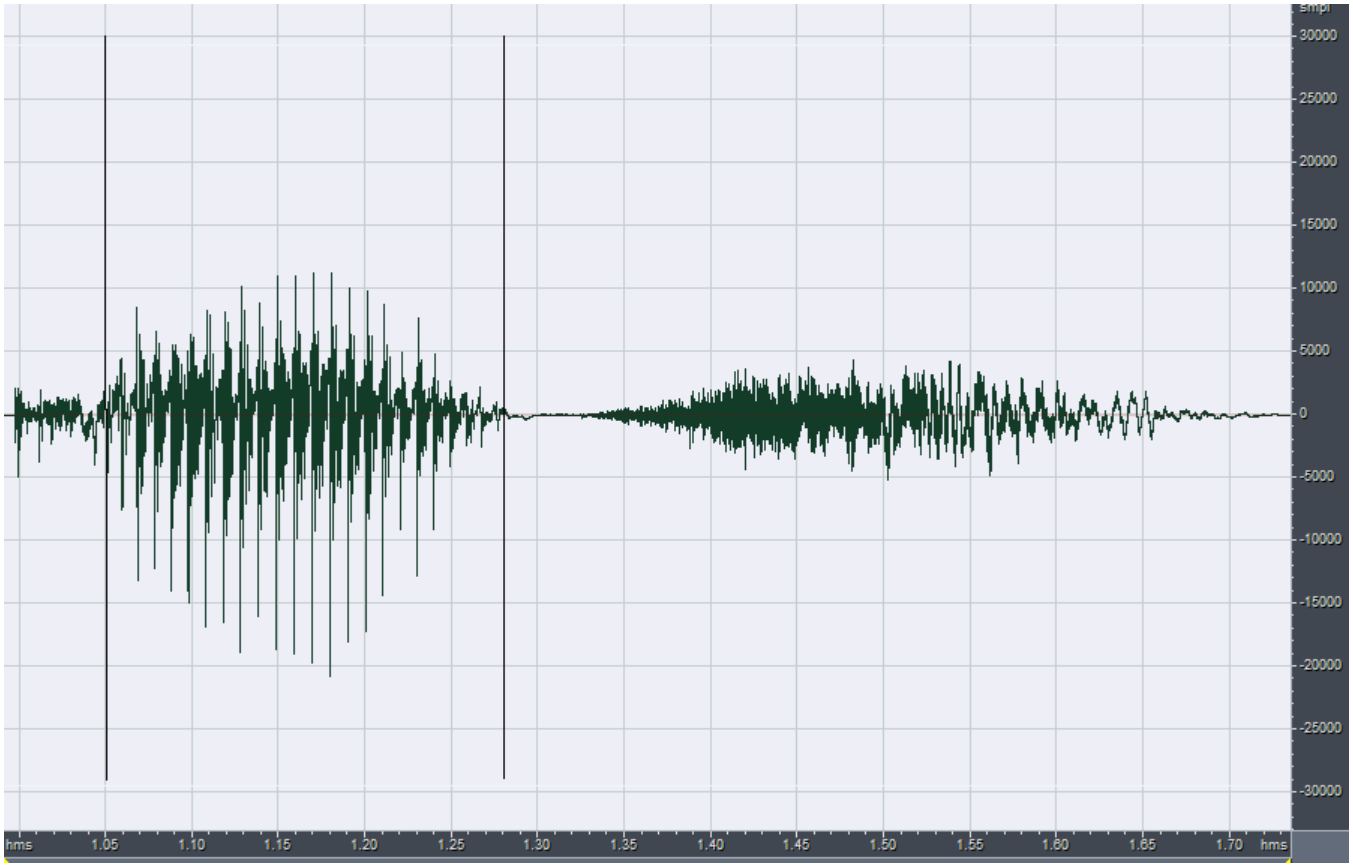

Figure 6. Example of the word “cats” with vowel onset and offset shown

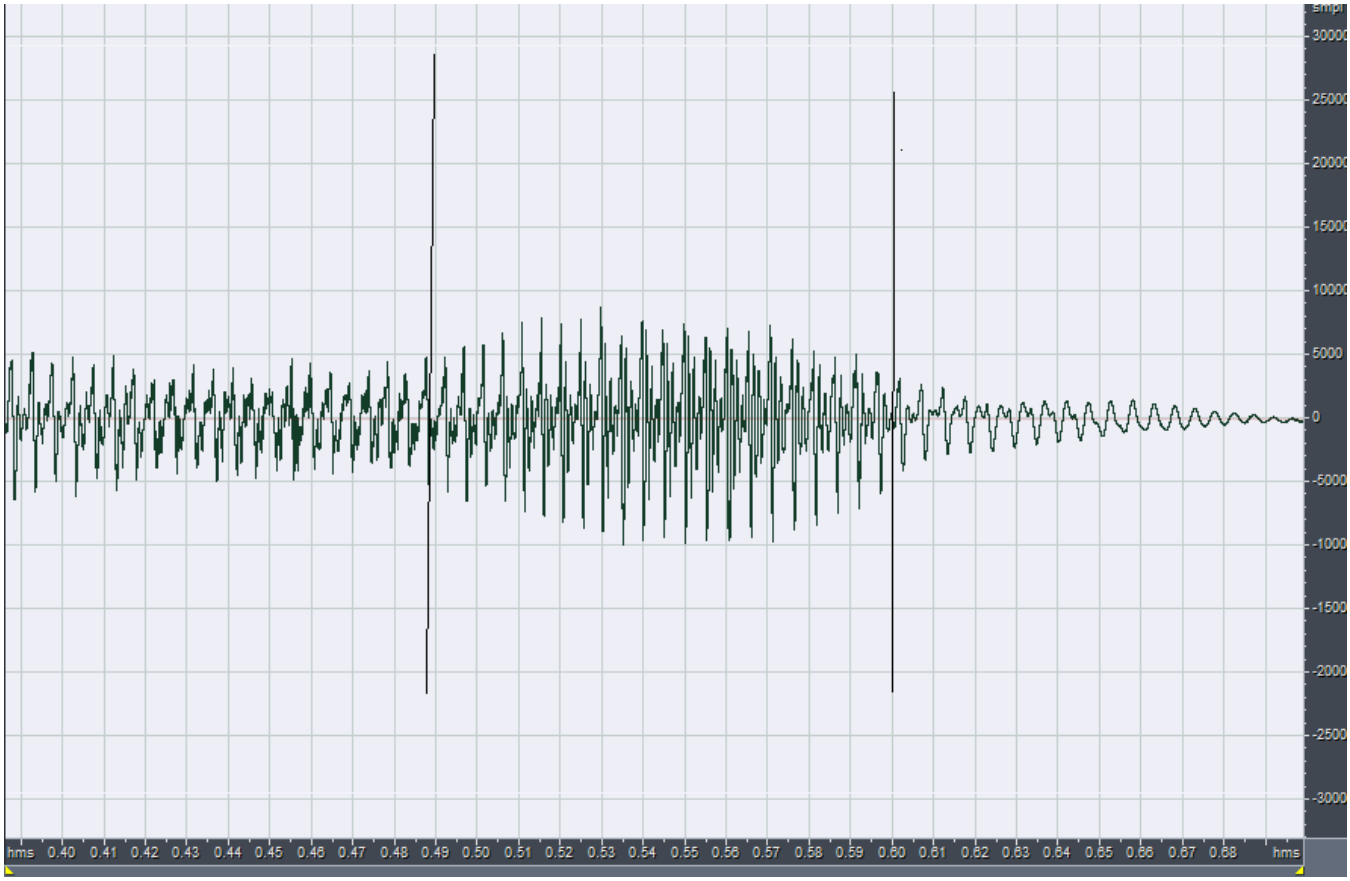

Figure 7. Example of the word “have” with vowel onset and offset shown

Figure 8 shows a talks location check program, which was used to check on the acoustic landmark locations. The first image shown in the figure is a waveform of the whole utterance said containing the word "kids." From that point the word was taken out of the utterance and the word onset and offset were measured. The second image in figure 8 shows the token word "kids." The final image in the figure shows the vowel /ɪ/ taken out of the word "kids," and shows the beginning and end of the vowel.

Figure 9 also shows the formant analysis done in the Matlab program. The formant peaks with the red vertical lines cutting through them represent the first, second, third, fourth, and fifth formants of the vowel being measured. Although all five formants are shown in the figure, the first two formants are the most important because they distinguish the vowel shown from other vowels. The first formant corresponds to tongue height, while the second formant corresponds to tongue front or backness. Using this information, one can easily determine which vowel is being said based on tongue position in the oral cavity. Formant frequencies (F1 and F2) were measured automatically at five points in time, 20%, 35%, 50%, 65%, and 80%. The F1 and F2 values corresponding to these time points were then used in statistical analysis to assess the changes in vowel production. Figure 10 shows the formant analysis in the custom Matlab program with the five points in time shown.

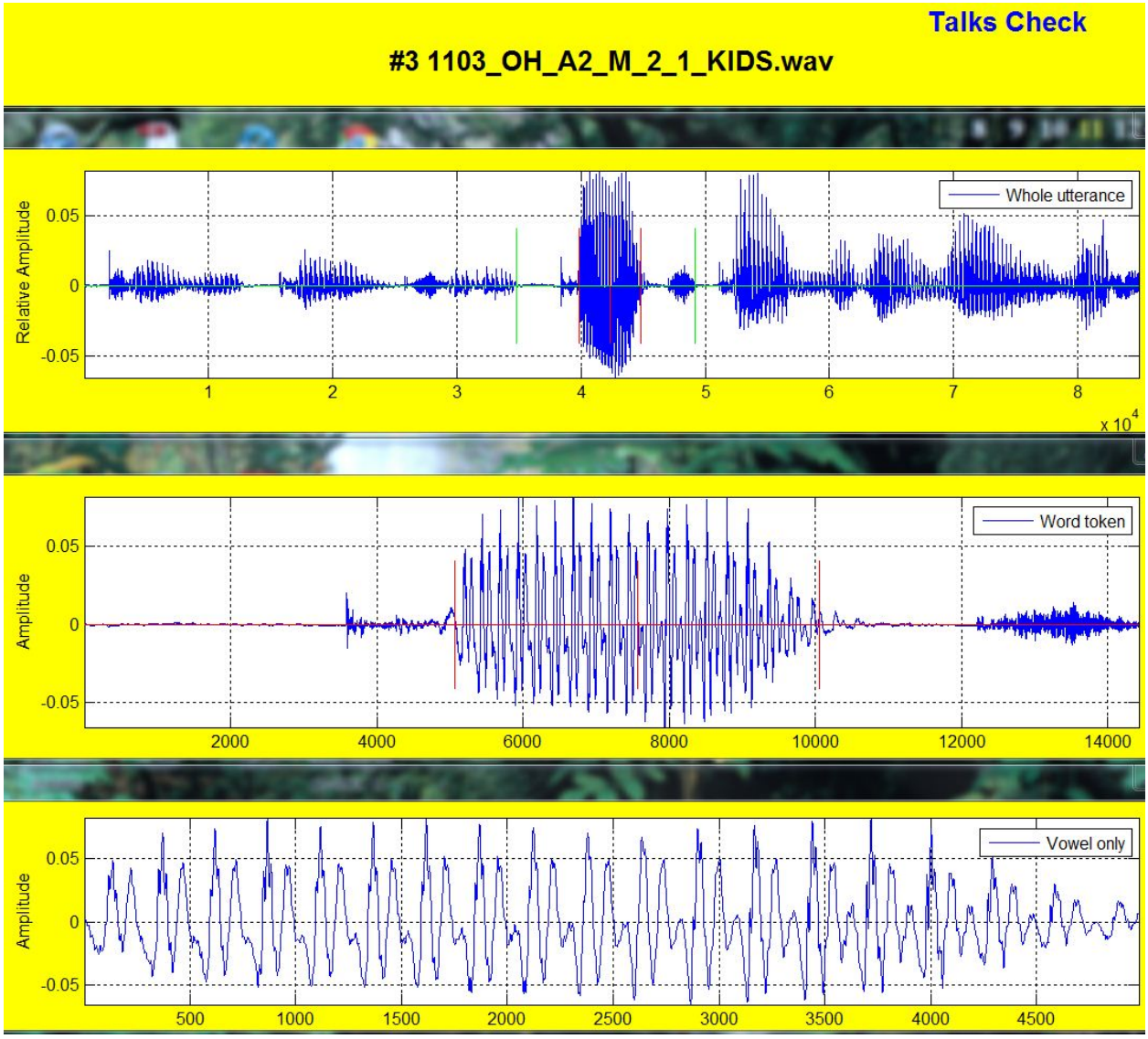

Figure 8. Acoustic landmark locations in a talk waveform (upper panel), along with word waveform, (middle panel), and vowel waveform (lower panel).

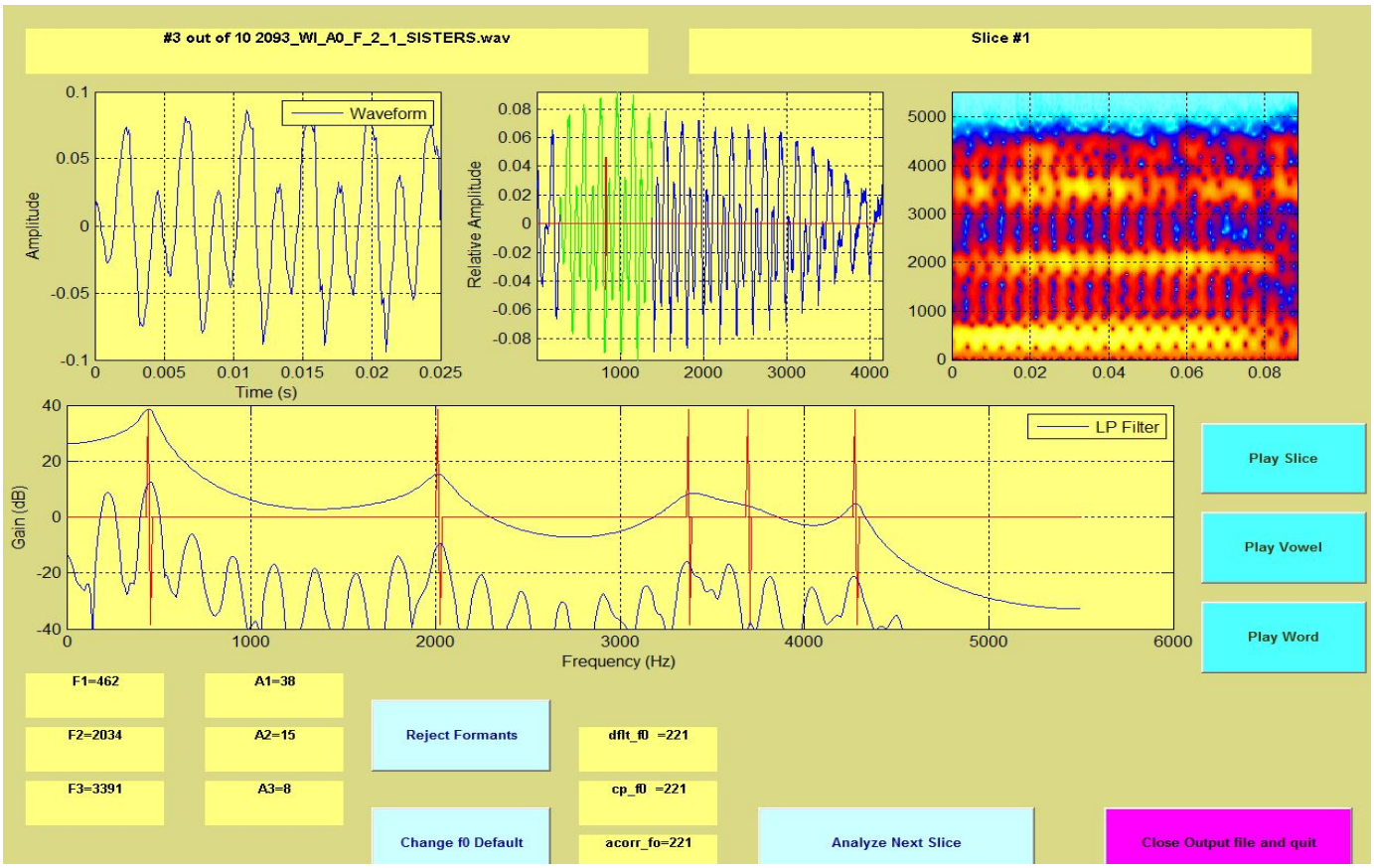

Figure 9. Formant analysis using Matlab program

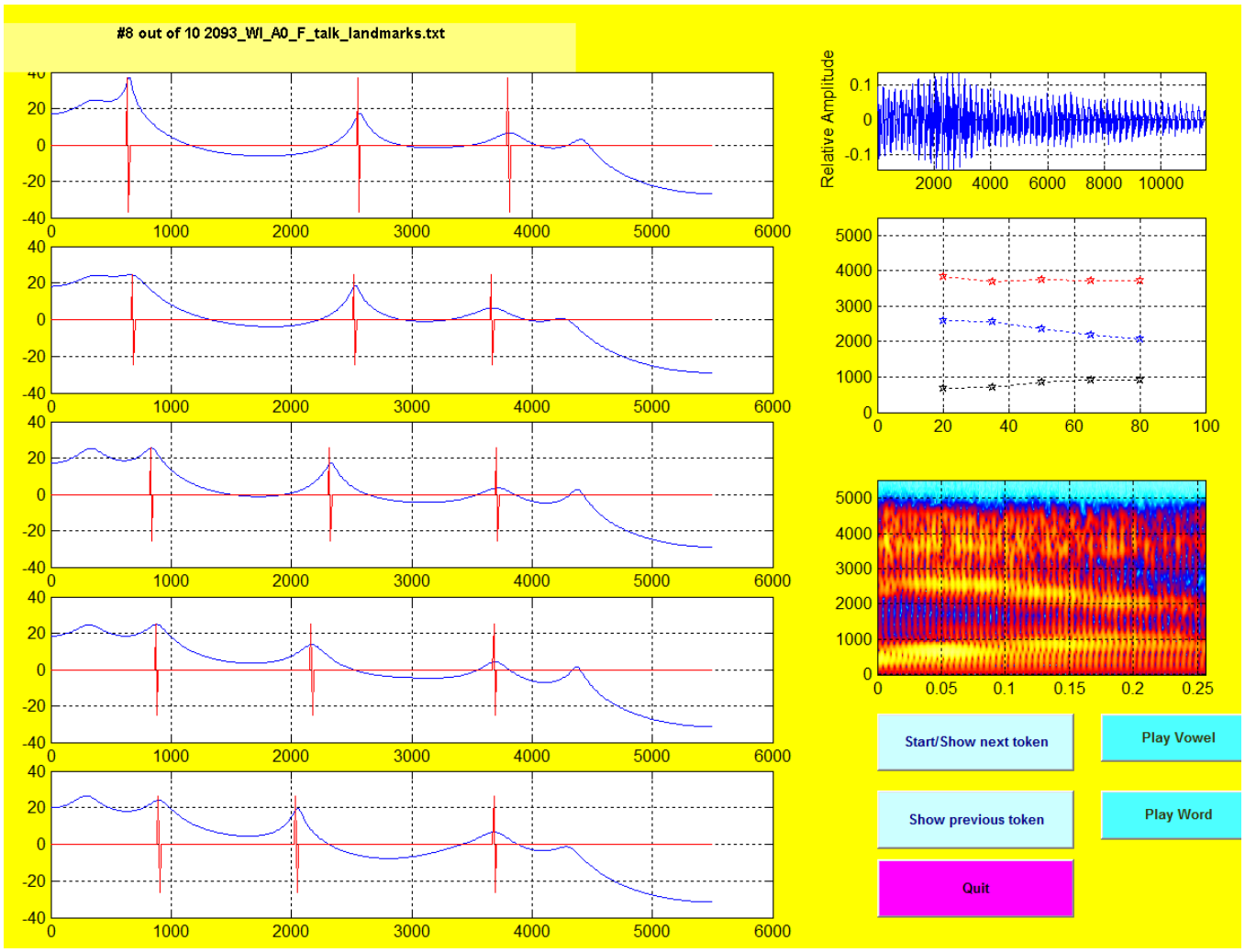

Figure 10. Check of formant frequencies at five points

Chapter 3: Results

3.1 Vowel Duration Analysis

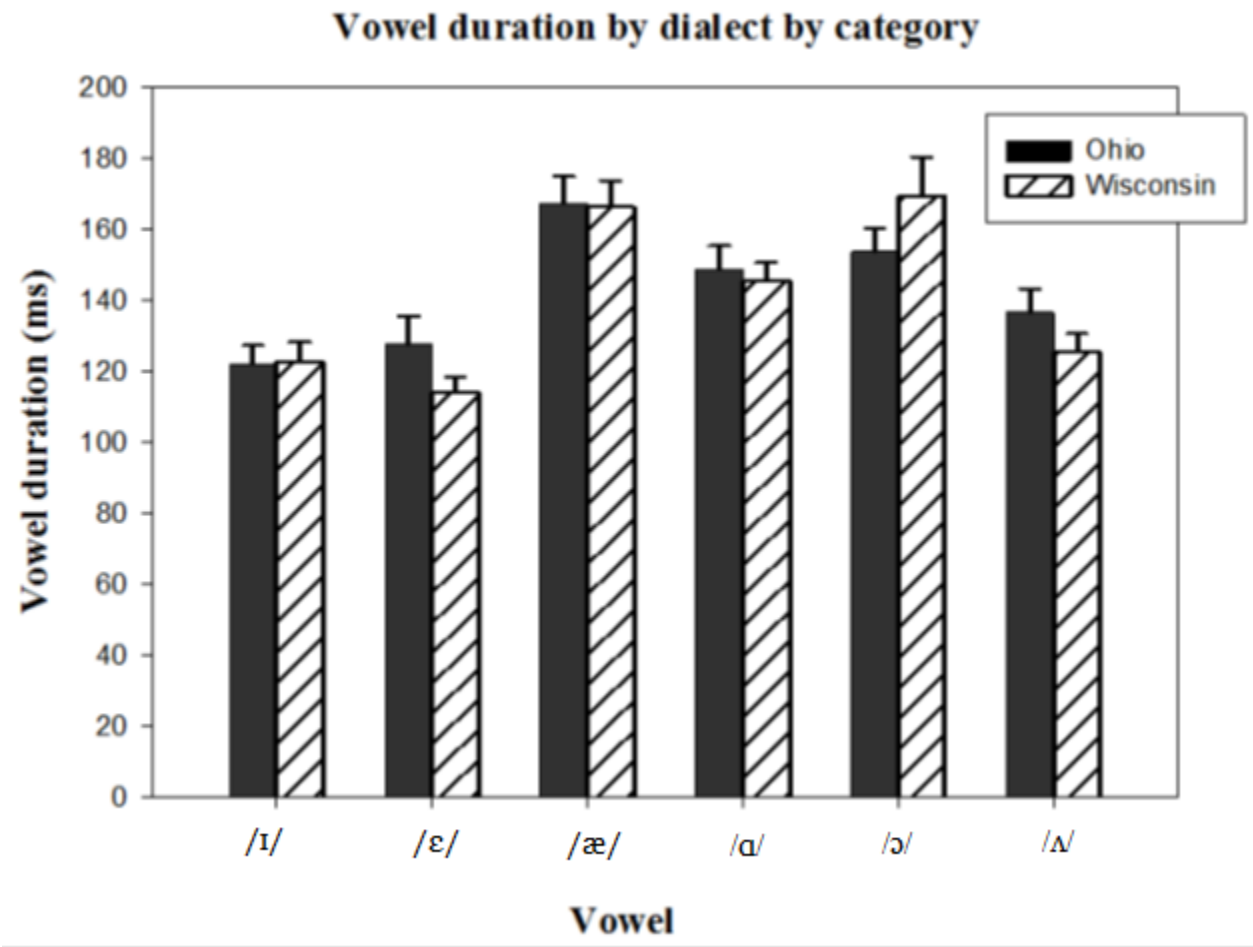

Figure 11. Vowel Duration by dialect by category

Figure 11 displays the duration of individual vowel categories in each dialect. Overall mean vowel duration is longer for Ohio speakers than for Wisconsin speakers. Vowel duration was measured in milliseconds. The means were 142.4 and 138.7 m.s., respectively. In regards to gender, the mean

vowel duration for females was 143.5 and for males was 136.8 m.s. This shows that females have longer vowels than males on average. In terms of generations, children had the longest vowel duration, parents had shorter vowel duration, and grandparents had the shortest vowel duration. The means were 147.7, 137.5, and 135.8 m.s., respectively. According to Figure 8, the vowel /æ/ is longest for both Ohio and Wisconsin speaker production. The /ɔ/ vowel is almost equally as long when produced by Wisconsin speakers but is comparably shorter when produced by Ohio speakers. The figure also shows that production of /ɛ/ is shortest for Wisconsin speakers, followed by /ɪ/. For Ohio speakers, however, it appears that the production of /ɪ/ is shortest, followed by the production of /ɛ/.

3.2 Frequency Analysis

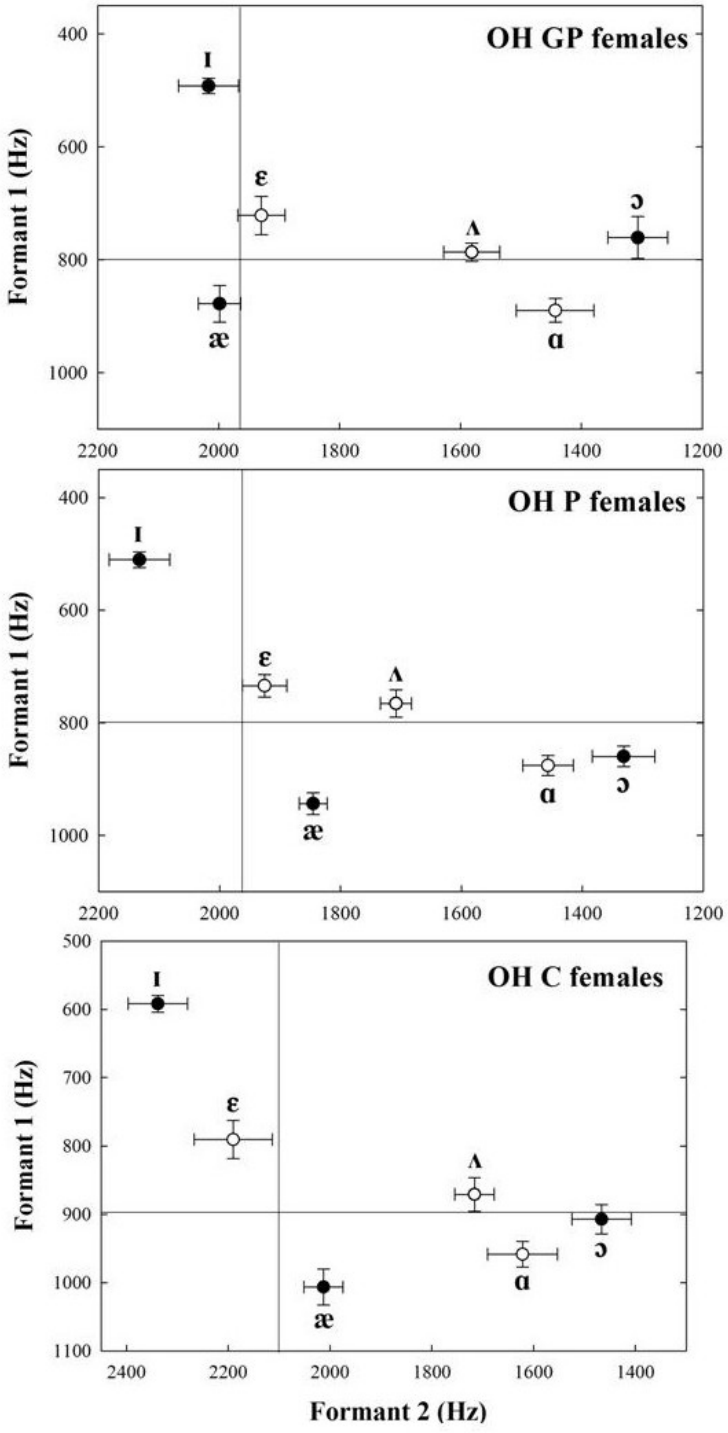

Figure 8. Midpoints and standard error of OH Female speakers

The /ɪ/ vowel is fronted and lowered across all generations of speakers. /ɛ/ is lowered across all generations and moves forward from the A2 to A0 speaker group. /æ/ shows a retraction and lowering from the A4 to A2 speakers but moves forward and down from A2 to A0 speakers. /ɑ/ shows minimal movement between the A4 and A2 generations but lowers and fronts from the A2 to A0 generations. /ʌ/ is fronted and slightly raised from the A4 to A2 speakers and is lowered from the A2 to A0 speakers. /ɔ/ moves forward and down across all generations of speakers. The movement of the /ɑ/ and /ɔ/ vowels results in a partial merger or the vowels, the cot/caught merger. There is no evidence of the cot/caught merger in grandparents and only occurs in parents and children, thus this shift only occurs in younger speakers.

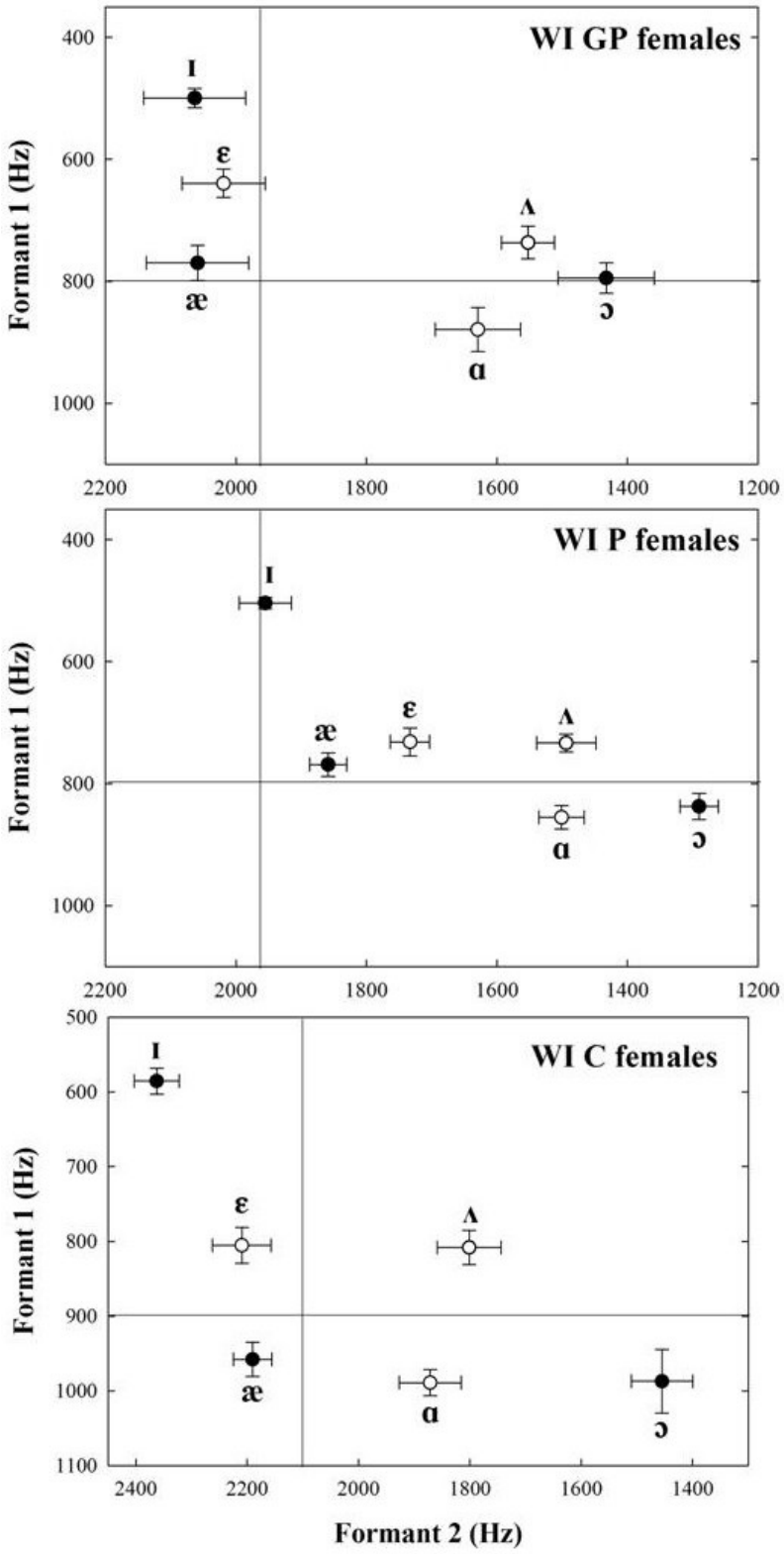

Figure 9. Midpoints and standard error of WI female speakers

The /ɪ/ vowel is retracted from the A4 to A2 generation of speakers but moves forward and down from the A2 to A0 generation of speakers. /ɛ/ moves back and down (stage 4) from the A4 to A2 speakers but moves forward and down from the A2 to A0 speakers. /æ/ is retracted from the A4 to A2 speakers but moves forward and down from the A2 to A0 speakers. /ɑ/ is retracted from the A4 to A2 speakers but moves forward and down from the A2 to A0 speakers. /ʌ/ moves slightly forward from the A4 to A2 generations and moves forward and down from the A2 to A0 generation speakers. /ɔ/ is retracted and lowered from the A4 to A2 speakers but moves forward and down from the A2 to A0 speakers.

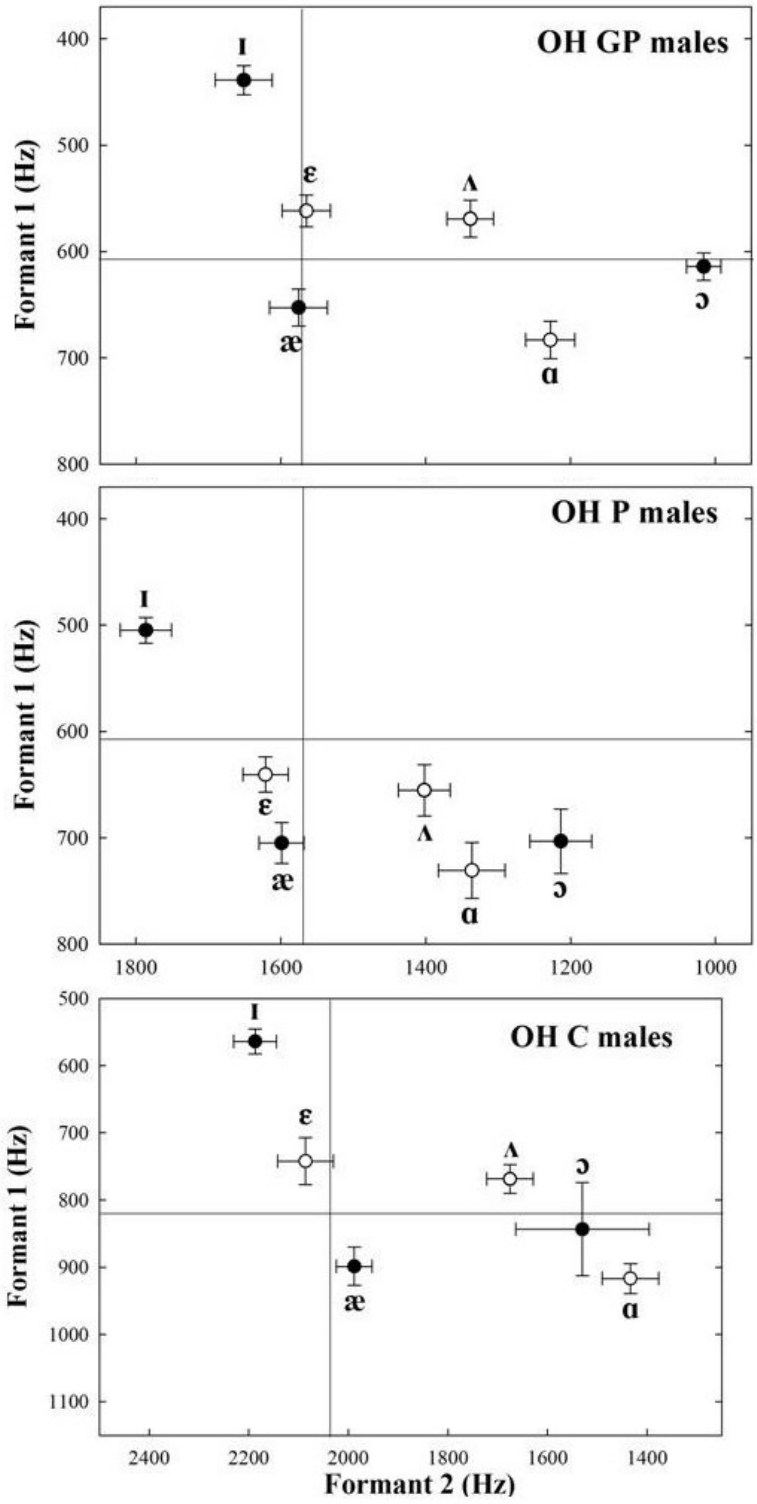

Figure 10. Midpoints and standard error of OH male speakers

There are positional vowel changes across generations of Ohio male speakers. All vowels /ɪ, ɛ, æ, ʌ, ɑ, and ɔ/ are lowered and fronted across all generations. This is interesting because there is much more consistency in the movement of vowels for Ohio male speakers as compared to Ohio female speakers or Wisconsin male speakers.

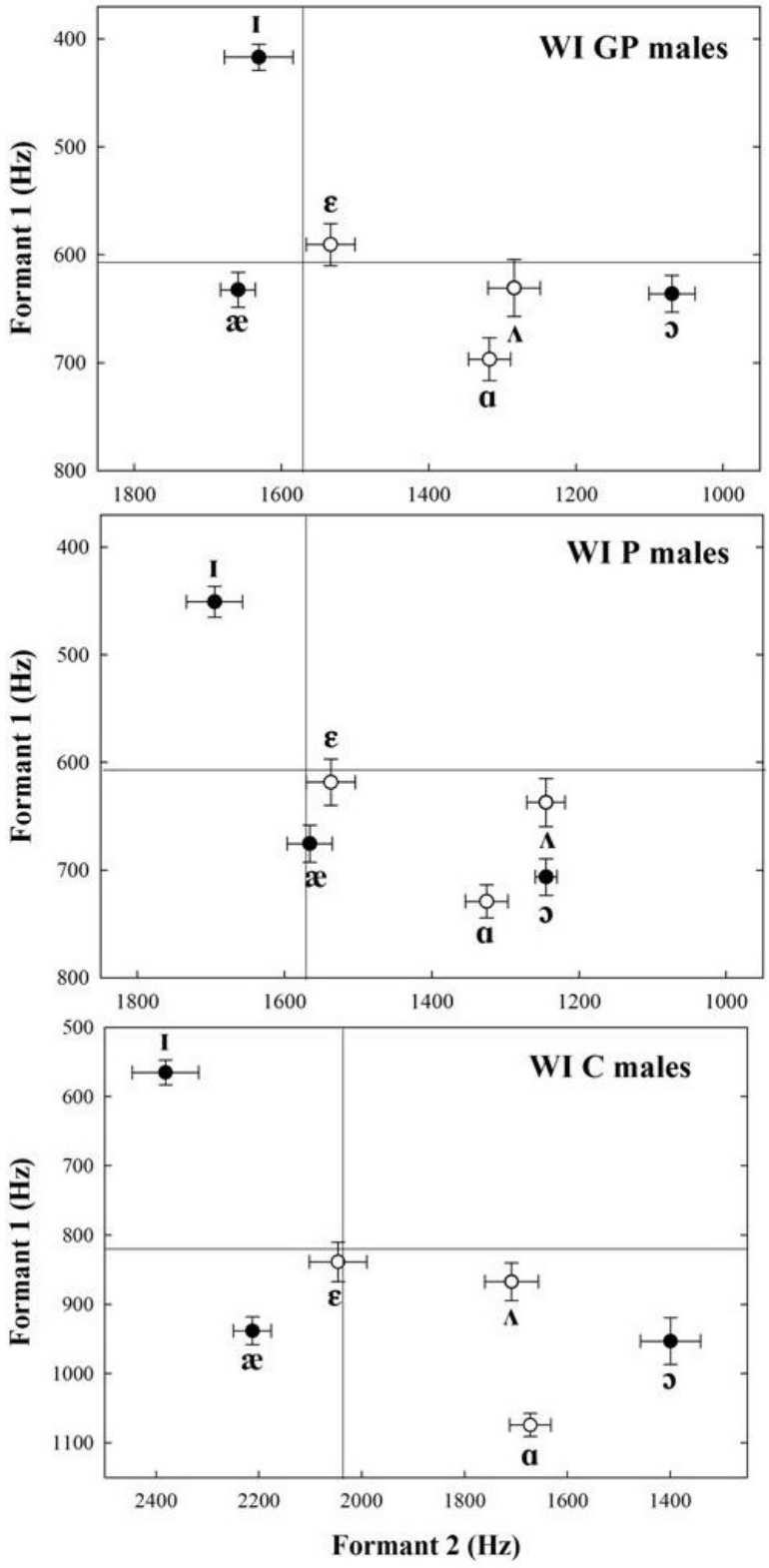

Figure 11. Midpoints and standard error of WI male speakers

There are several positional vowel changes in WI _A2 speakers relative to WI_A4 speakers. The vowel /ɪ/ moves forward and down from the grandparent to the parent generation. This vowel movement continues into the WI_A0 speakers and the /ɪ/ moves further forward and down. The /ɛ/ vowel moves forward and lower across all generations of speakers. /æ/ is retracted and lowered from A4 to A2 speakers but moves forward and down from A2 to A0 speakers. Although the horizontal movement of the vowel in the vowel space varies from generation to generation, /æ/ continues to lower throughout all generations of speakers. /ʌ/ has little movement from A4 to A2 speakers but moves forward and down from A2 to A0 speakers. /ɑ/ moves lower from A4 to A2 speakers and is fronted and lowered from A2 to A0 speakers. /ɔ/ moves forward and down across all generations of speakers.

Chapter 4: Discussion / Conclusion

The purpose of this study was to determine whether or not elements of the Northern Cities shift have spread to the spontaneous speech of Central Ohio speakers as seen in changes in the positions of vowels in the acoustic vowel space across age groups. Primary results indicate that the Northern Cities Shift has not spread to the spontaneous speech of Central Ohio Speakers. These results are consistent with results of previous research studies that show that the Northern Cities shift is not operative in Central Ohio. Findings by Jacewicz, Fox, and Salmons (2011) have suggested that speakers in the Central Ohio region do in fact participate in a chain shift. This is a new shift in Central Ohio, the North American Shift. However, the data supporting this view are based on recordings from read speech obtained under careful laboratory conditions. While the current spontaneous speech data support the existence of the new North American Shift, there is no indication of any traces of the Northern Cities Shift in the speech of the present participants.

Previous data from Labov et al., (2006) indicate a strong dialect boundary between the North and the Midland that divides Ohio into two dialect regions. Because the data used in Labov's study comes from speakers interviewed between 1991 and 1993, the results may have changed in the past twenty years. This study presents a current view on the dialect boundary. The results from this study are consistent with Labov's data. Since the Northern Cities Shift has not spread from Northern to Central Ohio, it can be concluded that there is still a strong dialect boundary between the North and the Midland.

The results of this study are relevant to research in Speech and Hearing Science because it provides further evidence that the Northern Cities Shift is not present in the spontaneous speech of Central Ohio speakers. This shows that the Northern Cities Shift has not changed across generations of Central Ohio speakers in the past twenty years. In research it is important to continue to update your findings with current populations.

Potential weaknesses of this study include the variability of speakers and the variety of target words used. Because the study uses recorded materials of spontaneous speech, each speaker has great variability and it can sometimes be hard to correctly transcribe what was said. The spontaneous talks used present an innovation in studies of the Northern Cities Shift because most previous studies have used controlled recordings. Although the study provides a more accurate sample of everyday speech, it is harder to control the conditions of the study.

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Appendix A

Basic demographic background of the participants (self reported). Education level is coded as: 1 = elementary, 2 = high school, 3 = two-year college, 4 = four-year college, 5 = graduate degree. ID: C = child, P = parent, GP = grandparent.

Ohio participants

ID	Birth year	Age at testing (years)	Gender	Education	Occupation	Area
OH1030_C	1994	12	F	1	Student	Columbus
OH1031_C	1996	10	M	1	Student	Columbus
OH1037_C	1995	11	F	1	Student	Columbus
OH1049_C	1995	12	M	1	Student	Columbus
OH1056_C	1997	10	M	1	Student	Columbus
OH1057_C	1998	9	F	1	Student	Columbus
OH1058_C	1997	10	M	1	Student	Columbus
OH1061_C	1997	10	M	1	Student	Worthington
OH1063_C	1995	12	M	1	Student	Powell
OH1065_C	1997	10	M	1	Student	Columbus
OH1067_C	1995	12	F	1	Student	Worthington
OH1069_C	1997	10	M	1	Student	Westerville
OH1072_C	1996	11	M	1	Student	Granville
OH1073_C	1998	9	F	1	Student	Granville
OH1075_C	1995	8	F	1	Student	Upper Arlington
OH1078_C	1994	12	F	1	Student	Columbus
OH1083_C	1998	9	F	1	Student	Grove City
OH1088_C	1994	12	F	1	Student	Glenford
OH1092_C	1998	9	F	1	Student	Columbus
OH1039_P	1962	44	M	5	Bus driver	Columbus
OH1046_P	1968	39	M	5	Research assistant	Columbus

OH1051_P	1968	39	F	4	University staff	Worthington
OH1062_P	1968	39	F	3	Preschool teacher	Powell
OH1068_P	1970	37	F	5	Substitute teacher	Worthington
OH1071_P	1965	42	F	4	Homemaker, previous teacher	Grandville
OH1076_P	1965	42	F	5	Speech language pathologist	Columbus
OH1077_P	1958	49	F	3	Nurse	Columbus
OH1089_P	1963	44	M	4	Graphic designer	Grandview Heights
OH1090_P	1969	38	F	5	Homemaker	Hilliard
OH1093_P	1968	39	F	4	Homemaker	Columbus
OH1094_P	1960	47	F	5	Occupational therapist	Worthington
OH1103_P	1958	49	M	3	Compliance facility director	Columbus
OH1104_P	1965	42	F	4	Registered nurse	Columbus
OH1111_P	1973	35	M	5	Teacher	Westerville
OH1112_P	1972	35	M	4	IT technician	Hilliard
OH1113_P	1968	39	F	4	University staff	Columbus
OH1127_P	1964	44	M	5	Student	Ashville
OH1140_P	1973	36	M	4	Retired, private investor	Columbus
OH1052_GP	1935	72	M	5	Retired manager	Worthington
OH1053_GP	1939	68	F	2	Retired	Columbus
OH1054_GP	1935	72	F	3	Beautician	Columbus
OH1098_GP	1931	76	F	3	Retired	Columbus
OH1106_GP	1938	69	M	3	School bus driver	Columbus
OH1118_GP	1935	73	M	5	Retired	Columbus
OH1119_GP	1934	74	M	2	Retired	Delaware
OH1121_GP	1939	69	M	2	Retired	Columbus
OH1128_GP	1937	71	F	3	Homemaker	Groveport
OH1130_GP	1940	68	M	2	Retired Telephone Co worker	Columbus
OH1131_GP	1931	77	F	2	Homemaker	Columbus
OH1132_GP	1932	76	F	3	Retired legal secretary	Columbus
OH1133_GP	1940	68	M	3	Retired	Columbus

OH1141_GP	1934	75	F	4	Retired teacher	Westerville
OH1129_GP	1937	71	M	4	Retired fire fighter	Columbus

Wisconsin Participants

ID	Birth year	Age at testing (years)	Gender	Education	Occupation	Area
W2088_C	1995	12	F	1	Student	Madison
W2089_C	1998	9	F	1	Student	Madison
W2091_C	1997	10	F	1	Student	Madison
W2093_C	1996	11	F	1	Student	Madison
W2095_C	1997	9	F	1	Student	Madison
W2098_C	1997	9	F	1	Student	Monona
W2099_C	1999	9	F	1	Student	Madison
W2100_C	1999	8	F	1	Student	Madison
W2101_C	1995	12	F	1	Student	Madison
W2102_C	1998	9	F	1	Student	Madison
W2103_C	1998	9	M	1	Student	Madison
W2116_C	1998	9	M	1	Student	Middleton
W2117_C	1999	9	M	1	Student	Middleton
W2118_C	1999	9	M	1	Student	Middleton
W2120_C	1997	10	M	1	Student	Madison
W2121_C	1998	9	M	1	Student	Middleton
W2124_C	1999	8	M	1	Student	Middleton
W2131_C	1997	10	M	1	Student	Madison
W2132_C	1997	10	M	1	Student	Madison
W2133_C	1997	11	M	1	Student	Madison
W2040_P	1968	38	M	5	Researcher	Sun Prairie
W2041_P	1964	42	M	4	Unemployed	Madison
W2042_P	1967	39	F	5	Financial specialist	Madison
W2045_P	1961	45	F	5	Trial attorney	Madison
W2048_P	1960	46	F	4	Health unit coordinator	Madison

W2051_P	1968	38	F	4	Health care manager	Madison
W2052_P	1968	38	F	5	Network engineer	Madison
W2054_P	1961	45	F	4	Small business owner	Oregon
W2055_P	1962	44	M	5	Electrical engineer	Oregon
W2057_P	1957	50	M	5	University professor	Madison
W2058_P	1966	41	F	5	Director of development	Verona
W2062_P	1970	36	F	4	Registered nurse	Madison
W2068_P	1960	46	M	5	Research program manager	Madison
W2076_P	1959	47	F	3	Correction officer	Fond du lac
W2079_P	1958	49	F	5	Attorney	Madison
W2081_P	1966	40	M	5	Teacher (Middle school)	Madison
W2092_P	1959	48	M	5	Student	Madison
W2129_P	1968	40	M	3	Clerk at Walgreens	Sun Prairie
W2049_GP	1928	79	M	3	Retired	Madison
W2061_GP	1936	70	M	5	Retired physician	Madison
W2070_GP	1936	70	M	4	Retired civil engineer	Madison
W2071_GP	1931	75	F	2	Retired	Monona
W2072_GP	1931	75	M	5	Retired	Madison
W2073_GP	1932	74	F	4	Retired	Madison
W2080_GP	1931	76	M	5	Professor	Madison
W2083_GP	1924	83	F	2	Florist, retired teacher	Madison
W2086_GP	1920	86	F	2	Retired registered nurse	Madison
W2087_GP	1924	83	F	4	Retired registered nurse	Monona
W2104_GP	1932	75	M	5	Retired –VP purchasing	Madison
W2128_GP	1935	72	F	5	Registered nurse	Madison
W2130_GP	1939	68	M	3	Retired farmer	Sun Prairie
W2134_GP	1918	90	F	1	Retired	De Forest
W2135_GP	1922	85	M	5	Retired	Madison
W2142_GP	1935	72	F	2	Retired	Menominee Falls

Appendix B

Vowel	Word	Frequency	Percent
2	BIG	16	8.0
2	BIGGER	3	1.5
2	BIGGEST	1	.5
2	BIT	3	1.5
2	BUSINESS	2	1.0
2	BUSINESSES	1	.5
2	BUSY	1	.5
2	CHIP	1	.5
2	CHRISTMAS	1	.5
2	CITY	2	1.0
2	DID	27	13.4
2	DIDNT	2	1.0
2	DIFFERENT	2	1.0
2	DIG	1	.5
2	DISTANCE	1	.5
2	DISTRICT	1	.5
2	FIFTEEN	1	.5
2	FIFTH	6	3.0
2	FIFTY	1	.5
2	FISHED	1	.5
2	GET	1	.5
2	GIFTS	2	1.0
2	GIVE	1	.5

2	HIS	6	3.0
2	HIT	1	.5
2	IF	1	.5
2	IS	14	7.0
2	IT	17	8.5
2	ITS	11	5.5
2	KID	4	2.0
2	KIDS	17	8.5
2	KITCHEN	1	.5
2	LITTER	1	.5
2	LIVED	1	.5
2	LIVES	1	.5
2	MIDDLE	1	.5
2	PHYSICAL	1	.5
2	PIP	1	.5
2	RISKING	1	.5
2	SIBLINGS	1	.5
2	SICK	3	1.5
2	SINK	1	.5
2	SISTER	3	1.5
2	SISTERS	2	1.0
2	SIT	2	1.0
2	SIX	8	4.0
2	SIXTY	1	.5
2	SKIP	1	.5
2	SMITH	1	.5
2	THIS	16	8.0

2	VIDEO	1	.5
2	VIDEOS	1	.5
2	VIRGINIA	1	.5
2	VISIT	2	1.0
4	BED	5	2.8
4	BEDROOM	1	.6
4	BEDS	3	1.7
4	BEDSET	1	.6
4	BEST	6	3.4
4	BETTER	2	1.1
4	BLESSED	1	.6
4	CHESS	1	.6
4	DECADES	1	.6
4	DECK	1	.6
4	DESERT	1	.6
4	DESK	1	.6
4	DESTINY	1	.6
4	DEVIL	1	.6
4	DEVILS	1	.6
4	EDGE	2	1.1
4	EDGEWOOD	1	.6
4	EFFORT	1	.6
4	EVER	5	2.8
4	EVERGLADES	1	.6
4	EVERY	6	3.4
4	EVERYONE	1	.6
4	EVERYTHING	1	.6

4	EXODUS	1	.6
4	F	1	.6
4	FEZ	1	.6
4	FORGET	1	.6
4	GET	18	10.2
4	GETS	4	2.3
4	GETTING	1	.6
4	GUESS	7	4.0
4	HEAD	3	1.7
4	JETSKI	1	.6
4	KEPT	2	1.1
4	LEFT	3	1.7
4	LEGS	1	.6
4	MET	6	3.4
4	NEVER	1	.6
4	NEXT	1	.6
4	PET	4	2.3
4	PRESENT	1	.6
4	SAID	10	5.6
4	SAYS	1	.6
4	SECOND	13	7.3
4	SECONDS	1	.6
4	SECRETARY	1	.6
4	SECTOR	1	.6
4	SEMESTER	1	.6
4	SET	1	.6
4	SETTLED	1	.6

4	SEVEN	13	7.3
4	SEVENTH	2	1.1
4	SEVERAL	1	.6
4	SPECIAL	1	.6
4	STEP	1	.6
4	STEPS	1	.6
4	TEST	3	1.7
4	TEXAS	4	2.3
4	THEN	1	.6
4	TOGETHER	2	1.1
4	UPSET	2	1.1
4	WEATHER	1	.6
4	WEST	2	1.1
4	WESTERVILLE	1	.6
4	YES	9	5.1
4	YET	1	.6
5	ACTS	1	.5
5	ACTUALLY	7	3.4
5	ADDED	1	.5
5	AFTER	2	1.0
5	ASK	1	.5
5	AT	2	1.0
5	ATHLETIC	1	.5
5	AVENUE	1	.5
5	BACK	37	17.8
5	BAD	6	2.9
5	BASKETBALL	4	1.9

5	BATH	1	.5
5	BATTLE	1	.5
5	CAT	4	1.9
5	CATHOLIC	2	1.0
5	CATS	3	1.4
5	CHAPTERS	1	.5
5	CHAT	1	.5
5	DAD	17	8.2
5	DADS	2	1.0
5	FACT	4	1.9
5	FACTS	1	.5
5	FAST	1	.5
5	GAS	2	1.0
5	HAD	10	4.8
5	HALF	1	.5
5	HAS	2	1.0
5	HAT	1	.5
5	HAVE	26	12.5
5	JACK	1	.5
5	LAST	1	.5
5	MADISON	3	1.4
5	PACKERS	1	.5
5	PACMAN	1	.5
5	PADDLE	1	.5
5	PADS	1	.5
5	PASS	1	.5
5	PASSES	1	.5

5	PAST	1	.5
5	PATHS	1	.5
5	PATTERN	1	.5
5	SACK	1	.5
5	SAT	1	.5
5	SHAFTS	1	.5
5	THAT	38	18.3
5	THATS	7	3.4
5	TRACK	1	.5
5	TRAVELED	1	.5
5	ZACK	1	.5
6	ADOPTED	1	.5
6	AHS	1	.5
6	BACH	1	.5
6	BARS	1	.5
6	BOBBY	1	.5
6	BODY	1	.5
6	BOTTLE	1	.5
6	BOX	2	1.1
6	CHICAGO	3	1.6
6	CLOCK	2	1.1
6	COMMON	1	.5
6	COPS	1	.5
6	COSTUMES	1	.5
6	COTTAGE	2	1.1
6	DOCK	1	.5
6	DOCTOR	1	.5

6	DODGE	1	.5
6	FATHER	12	6.6
6	FATHERS	2	1.1
6	GOD	3	1.6
6	GODS	1	.5
6	GOT	47	25.7
6	GOTTEN	2	1.1
6	HOBBS	1	.5
6	HOCKEY	2	1.1
6	HOP	1	.5
6	HOSPITAL	1	.5
6	HOT	1	.5
6	JOB	9	4.9
6	JOBS	5	2.7
6	JOSH	1	.5
6	LOCKED	1	.5
6	LOCKER	1	.5
6	LOT	15	8.2
6	LOTS	2	1.1
6	MENOMINEE	1	.5
6	NOT	4	2.2
6	OBVIOUS	1	.5
6	OCCUPY	1	.5
6	OFTEN	1	.5
6	OSCAR	2	1.1
6	OSHKOSH	2	1.1
6	PASTA	1	.5

6	PLOT	1	.5
6	POCKET	1	.5
6	POP	1	.5
6	POPULATION	1	.5
6	POSSIBLE	1	.5
6	PROBABLY	2	1.1
6	PROBLEMS	2	1.1
6	PROCESSED	1	.5
6	SCOTCH	1	.5
6	SHOP	3	1.6
6	SHOPPING	2	1.1
6	SHOT	1	.5
6	SOCCER	11	6.0
6	SPOT	2	1.1
6	STOP	6	3.3
6	STOPPED	2	1.1
6	STOPS	1	.5
6	TOP	1	.5
6	WISCONSIN	1	.5
10	AUDIT	1	1.0
10	AUGUST	2	1.9
10	AUSTRIA	1	1.0
10	AW	2	1.9
10	AWKWARD	1	1.0
10	BECAUSE	6	5.8
10	BOSS	1	1.0
10	BOSTON	2	1.9

10	BOUGHT	10	9.7
10	BROUGHT	2	1.9
10	CAUGHT	2	1.9
10	CAUSE	1	1.0
10	CAUSED	1	1.0
10	CLOGGING	1	1.0
10	CROSS	1	1.0
10	DAUGHTER	15	14.6
10	DAUGHTERS	3	2.9
10	DOG	2	1.9
10	DOGS	3	2.9
10	GONE	1	1.0
10	MILWAUKEE	2	1.9
10	OFF	4	3.9
10	OFFER	2	1.9
10	OFFICE	1	1.0
10	OFFICES	1	1.0
10	OFTEN	2	1.9
10	PAUSES	1	1.0
10	SAUSAGE	1	1.0
10	SLAUGHTER	1	1.0
10	SOCKS	2	1.9
10	SOD	1	1.0
10	SOFT	1	1.0
10	SOFTWARE	1	1.0
10	TALK	6	5.8
10	TALKED	1	1.0

10	TALKIN	1	1.0
10	TALKING	2	1.9
10	TAUGHT	2	1.9
10	THOUGHT	11	10.7
10	WALK	1	1.0
10	WAUKESHAH	1	1.0
11	ANOTHER	1	.6
11	BROTHER	2	1.1
11	BROTHERS	1	.6
11	BUCKS	1	.6
11	BUNCH	1	.6
11	BUS	4	2.2
11	BUST	1	.6
11	BUT	44	24.7
11	CHUCK	1	.6
11	COMPANY	2	1.1
11	COUSIN	2	1.1
11	COUSINS	2	1.1
11	CUP	1	.6
11	CUSSED	1	.6
11	CUSTARD	1	.6
11	DISGUSTING	1	.6
11	DOES	2	1.1
11	DOUBLE	1	.6
11	DUBLIN	1	.6
11	DUDGEON	1	.6
11	DUG	1	.6

11	GUTTER	1	.6
11	HUSBAND	2	1.1
11	JUDGE	1	.6
11	JUST	7	3.9
11	LOVE	2	1.1
11	LUCKY	1	.6
11	MOTHER	3	1.7
11	MUCH	2	1.1
11	MUST	1	.6
11	NOTHING	1	.6
11	OF	2	1.1
11	ONES	1	.6
11	OTHER	15	8.4
11	PLUS	1	.6
11	PUZZLES	1	.6
11	SOUTHERN	1	.6
11	STUDIES	2	1.1
11	STUFF	20	11.2
11	SUB	1	.6
11	SUBJECTS	1	.6
11	SUBURB	1	.6
11	SUCH	1	.6
11	TOUCH	3	1.7
11	TUBS	1	.6
11	UH	1	.6
11	UM	1	.6
11	UP	30	16.9

11	US	2	1.1